

**Part 1            General**

**1.1                SUMMARY**

- .1    Section Includes:
  - .1        General requirements that are common to sections found in Division 26 – Electrical.
- .2    This Section covers items common to Sections of Division 26.
- .3    All Drawings and all sections of the Specifications shall apply to and form an integral part of this section.
- .4    Carefully examine all plans and Specifications pertaining to this Contract and become familiar with all details. Visit the Site and determine all factors affecting this section of the Work and include all costs for same in Bid Opportunity.

**1.2                REFERENCES**

- .1    Canadian Standards Association (CSA International)
  - .1        CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
- .2    The electrical installation shall comply with the requirements of the Electrical Supply Authority, the latest edition of the Canadian Electrical Code, with all Provincial and Municipal Laws, Rules and Ordinances, and to the satisfaction of those persons having jurisdiction over same.
- .3    Notify the Contract Administrator of any discrepancies or conflicts with any regulation seven (7) Working days before Bid Opportunities close. Failing such notification, meet all such requirements without change to the Contract price.
- .4    In no instance shall the standard established by these Specifications and Drawings be reduced by any of the codes, rules or ordinances.
- .5    Health Canada / Workplace Hazardous Materials Information System (WHMIS)

**1.3                COORDINATION**

- .1    The Contractor is responsible for installing a complete, fully functional and fully operational system, and is responsible for reviewing all other trades' Drawings to ensure all electrical requirements are included in the Bid Opportunity price. Inform the Contract Administrator of any discrepancies during the Bid Opportunity process. Any discrepancies not identified, shall be incorporated by the Contractor at no cost during construction.
- .2    The Contractor is responsible for coordination with all other trades and Contractors on Site.

- .3 Through the Contractor, coordination shall include regular meetings, exchange of Shop Drawings and other technical information. Compile Working combined systems Drawings, where parts of the installation are complex or require input of several trades. Ensure the Contractor is in attendance and is aware of all coordination. Obtain and exchange schedules with all other trades and Contractors to ensure Work which impacts another trade or Contract is completed in sufficient time.
- .4 All Work is to be properly phased to enhance coordination. Where it is evident that Work outside of phase has inhibited the Work of another Contractor, the Contract Administrator shall reserve the right to instruct the Contractor to remove said Work at the cost of the Contractor.

#### **1.4 SUSTAINABLE DESIGN PROCEDURES**

- .1 The City of Winnipeg has established, with the design team, the target for sustainable goals for the project. The Contractor, its Subcontractors and suppliers will be required to participate in the process to realize the City of Winnipeg's sustainable goals.

#### **1.5 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- .3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

#### **1.6 SUBMITTALS**

- .1 Submit Shop Drawings, produce detailed data and samples in accordance with previous sections, as specified herein, and to Contract Administrator's satisfaction.
- .2 Shop Drawings submitted electronically (e.g. by email) shall comply with the following:
  - .1 Shop Drawings larger than 11 x 17 shall include a hard copy delivered separately by messenger the same day as the email copies.
  - .2 All necessary transmittals shall be included with the email submission.
  - .3 Emailed Shop Drawings shall comply in all respects with this section of the Specifications.
- .3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or Material.
- .4 Where applicable, include actual wiring, single line and schematic diagrams. Include all technical data and full details of each component.
- .5 Include wiring Drawings or diagrams showing interconnection with Work of other sections.
- .6 Shop Drawings of all equipment must be submitted to the Contract Administrator for review in sufficient time to enable him to retain them for at least ten (10) Working days.

- .7 Each applicable device to be highlighted or identified with an arrow.
- .8 Each applicable device to be tagged (e.g. light fixture type, motor tag, etc.).
- .9 Bind each system separately eg. P.A., CCTV, Intercom, Fire Alarm, etc. One common binder from one supplier will not be acceptable.
- .10 Shop Drawing submission shall include a photocopy of all applicable Specification sections showing a complete compliance/ non-compliance listing. Refer to spec. detail sheet "Shop Drawing Compliance List Sample" for example.
- .11 Division 26 shall check all Shop Drawings and make necessary changes, or cause the supplier to make necessary changes, prior to submission to the Contract Administrator. Shop Drawings will be reviewed by the Contract Administrator and if re-submission is required, Division 26 shall ensure that the supplier's Drawings have been changed to comply before returning them to the Contract Administrator for review again.
- .12 Review of the Shop Drawings by the Contract Administrator shall not relieve the Contractor from responsibility for errors and omissions therein.
- .13 Each Drawing submission to bear the following signed stamp, and shall include name of project, equipment supplier, and clause number equipment is specified under.

#### CONTRACTORS CERTIFICATION

This Drawing has been reviewed by  
(firm name)

All dimensions have been checked and found compatible with the Contract Drawings and all capacities, quantities, sizes, and other data contained in the Contract documents have been listed by the supplier on this Drawing and have been checked by the undersigned and found correct.

Date Per:

- .14 Clearly show division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Others" or "By Purchaser". Any item, equipment or description of Work shown on Shop Drawings shall form part of Contract, unless specifically noted to the contrary.
- .15 Provide field dimensions required by electrical suppliers and Subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related Drawings and obtain clarification from Contract Administrator if necessary.
- .16 Incomplete submissions will be returned for updating and re-submittal without Contract Administrator's review.
- .17 Manufacturer's Field Reports: submit manufacturer's written reports, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in other sections.

**1.7 QUALITY ASSURANCE**

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction and as per the conditions of Provincial or Territorial Act respecting manpower vocational training and qualification.

**1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste Materials for reuse and recycling in accordance with Division 1.

**1.9 SYSTEM STARTUP**

- .1 Upon completion of the project, demonstrate the operation, care and maintenance of all system equipment and components in the presence of the City of Winnipeg, or his representative, and the Contract Administrator. Obtain signed certification from the City of Winnipeg that such equipment was shown to be fully operational and that all necessary operating instructions have been provided.
- .2 Arrange and pay for services of manufacturer's factory service Contract Administrator to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

**1.10 DRAWINGS**

- .1 Drawings are intended to communicate the general design intent. They are not to be interpreted as a description of means and methods of construction. The Contractor is responsible for reviewing the Drawings and Specifications of this and all other trades on the project to ensure that they deliver a fully coordinated, complete and fully operational system. Any component or service not described, but reasonably obvious as required for completion shall be included by the Contractor at no cost.
- .2 Carefully examine all Drawings and Specifications relating to all Work, and all electrical Work indicated thereon shall be considered as a part of the Work by this section unless indicated otherwise. Prior to the date of the last addendum report at once to the Contract Administrator, any defect, discrepancy, omission or interference affecting the Work of this section, or the guarantee of same.
- .3 Install all equipment as shown or as specified and in accordance with manufacturer's approved Shop Drawings.
- .4 The Drawings accompanying these Specifications are intended to show the general arrangement and extent of the Work to be carried out, but the exact location and arrangement of all parts shall be determined as the Work progresses. The location of equipment, outlets, etc., as given on the Drawings are approximately correct, but it shall

be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural or architectural requirements. Such changes shall be implemented as directed by the Contract Administrator, without additional charge.

- .5 Electrical Drawings do not show all structural and other details. Architectural and structural conditions shall govern, and this Section shall make without charge, changes or additions to accommodate these conditions. Check all architectural plans, elevations and details for location of electrical devices, equipment and equipment to be connected.
- .6 Where Drawings indicate the general location and route to be followed by conduit, cable, etc., these locations must be governed by job conditions. Where the required conduit, cable, and boxes are not shown on Drawings or only shown diagrammatically, they shall be installed to conserve maximum head room and interfere as little as possible with free use of space through which they pass. Maximum clearance above floor shall be maintained under all suspended conduit and equipment, unless otherwise shown on the Drawings, or approved by the Contract Administrator.
- .7 Submit a complete set of Drawings for the proposed installation to the Inspection Department having jurisdiction and receive written approval before installation or fabrication of any equipment. No extra compensation will be allowed for any changes or rearrangement of any electrical apparatus or Materials necessary due to failure to receive this approval.

#### **1.11 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into operation and maintenance manuals specified.
- .2 Provide one copy of Operation and Maintenance manuals to Contract Administrator for review. Operation and Maintenance manuals will be reviewed by the Contract Administrator and if re-submission is required, ensure that the manuals have been changed to comply before returning them to the Contract Administrator for review again.
- .3 Include in operations and maintenance data:
  - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of the electrical installation.
  - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature alone is not acceptable.
  - .3 Wiring and schematic diagrams and performance curves.
  - .4 Names and addresses of local suppliers.
  - .5 Copy of reviewed Shop Drawings.
- .4 Provide four (4) complete, hard-backed, D-ring loose leaf Maintenance Manuals. These shall consist of typewritten or printed instructions for operating and maintaining all systems and equipment provided under this section of the Specification. Manuals shall also contain Shop Drawings, wiring diagrams, test results and manufacturer's brochures

on all equipment, together with typed index tab sheets. Manuals shall also contain a DVD with PDF files of the contents of the manuals.

- .5 As Work progresses, record on one (1) set of Contract Drawings, installed conduit layout as well as any approved changes and deviations from the original Contract and/or Working Drawings, including outlets, equipment and panel locations. Have these Drawings available for reference and inspection at all times. At completion of Work, submit to the Contract Administrator, at the Contractor's Costs, AutoCAD Record Drawings and one hardcopy set of Record Drawings. The Contract shall not be considered complete and no final payment shall be made until these Drawings are accepted by the Contract Administrator. Provide separate Drawings for each system in order not to "crowd" Drawings.

## **1.12 TEMPORARY LIGHTING AND POWER**

- .1 All temporary and construction lighting and power Work and costs for same are not included as part of the scope of the Work of this section. Refer to such clauses in other sections of the Specification.

## **1.13 EXAMINATION OF DOCUMENTS AND SITE**

- .1 Carefully examine all plans and Specifications pertaining to this Contract and become familiar with all details. Visit the Site and determine all factors affecting this section of the Work; include all costs for same in Bid Opportunity.

## **Part 2 Products**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Provide Materials and equipment in accordance with Div. 1.
- .2 Equipment and Material to be CSA certified or certified by an equivalent recognized certifying agency to meet Canadian Standards. Electrical equipment consisting of individual certified components must also have a CSA or equivalent certification for the entire assembly. Where there is no alternative to supplying equipment which is certified, obtain special approval from local Electrical Inspection Department or authority having jurisdiction.
- .3 Factory assemble control panels and component assemblies.
- .4 Submit for Contract Administrator's approval, a duplicate list of makes and types of all equipment and Materials for this project, prior to placing of orders for same. This shall be done within fourteen (14) days of the award of the project Contract to the Contractor in order to avoid delays in delivery and completion.
- .5 Any Material or equipment ordered or installed without the Contract Administrator's prior approval shall, if so directed by the Contract Administrator, be removed and replaced with approved Material or equipment without a change in the Contract price.

## **2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Supplier and installer responsibility is indicated in Motor Schedule on electrical Drawings, or in this Specification and related mechanical responsibility is indicated in Mechanical Equipment Schedule on mechanical Drawings and Specifications.
- .3 Refer to other Sections of this Specification and to Drawings for responsibilities for control wiring and conduit.

## **2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

## **2.4 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for type of conductors used.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows, and as indicated in other Specification sections:
  - .1 Nameplates: lamicoid 3mm thick plastic engraving sheet, black face with white core (black with white letters) lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
  - .2 Nameplates for equipment fed from emergency power or from emergency UPS power (increase nameplate size as required to suit wording) shall be red with white letters (red with white letters).
  - .3 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.

- .5 Nameplates for terminal cabinets, pullboxes and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Room names and numbers used shall be actual room names and numbers that will be used on the project. Co-ordinate and confirm with trades involved.
- .8 Co-ordinate names of equipment and systems with Mechanical section to ensure that identical names are used.
- .9 Nameplates for control devices: indicate equipment controlled.
- .10 Adjacent to each breaker in CDP type panelboards, provide and mount lamacoid nameplates identifying the respective load and location.
- .11 All convenience receptacles shall have a lamacoid size 1 plate on which the panel and circuit number from which it is fed, is indicated. The identification shall be mechanically secured to the coverplate on the appropriate outlet. Pressure indented adhesive strip nameplates are not acceptable and shall not be used.

## **2.6 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders (coloured plastic tapes) and branch circuit wiring (numbered wire markers). Conductor marker identification shall correspond with panel or terminal board directory information.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system. Colour coding used shall be documented by individual systems in Maintenance Manuals.
- .5 Insulated grounding conductors shall have a green finish and shall be used only as a grounding conductor.

## **2.7 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cable.
- .2 Colour coding to match existing where applicable.
- .3 Confirm colour coding with City of Winnipeg and Contract Administrator prior to start of Work.
- .4 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.
- .5 Colours: 25mm wide prime colour and 20mm wide auxiliary colour.

Prime

Auxiliary



Up to 250V (normal power)	yellow	
Up to 600V (normal power)	yellow	green
Up to 250V (emergency power)	yellow & red	
Up to 600V (emergency power)	yellow & red	green
Fire alarm	red	
Control	blue	

- .6 Other conduit systems as directed on Site; all conduit systems shall be identified.
- .7 Color outlet box covers to color designated and show circuit numbers in black felt marker on inside of covers.

## **2.8 WORKMANSHIP AND MATERIALS**

- .1 The installation shall consist of Material and equipment specified unless as provided herein. Electrical equipment provided under this Contract shall be built in accordance with EEMAC standards and shall be C.S.A. certified (or certified by an equivalent recognized certifying agency to meet Canadian Standards) and/or locally approved. All equipment supplied under this Contract shall be new and the best of its respective kind and of uniform pattern throughout.
- .2 Any Material or equipment ordered or installed without the Contract Administrator's prior approval shall, if so directed by the Contract Administrator, be removed and replaced with approved Material or equipment without a change to the Contract.
- .3 Replace inferior Work if so ordered by Contract Administrator without a change to the Contract.
- .4 Retain same foreman or superintendent on the job until completed, unless otherwise directed by the Contract Administrator.
- .5 All tradesmen shall carry all tools on their person at all times. Any tool not in use shall be under lock and key in an area authorized by the building supervisor.

## **2.9 REQUEST FOR EQUAL**

- .1 Shall be submitted to the Contract Administrator in accordance to B6.

## **2.10 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

**3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

**3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .2 Arrange for holes through exterior wall and roof to be flashed and made weatherproof.
- .3 All conduits to be hidden in all locations except mechanical and electrical rooms.

**3.4 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.
- .4 Coordinate receptacle locations in mechanical rooms with Mechanical Contractor prior to install.

**3.5 FIELD QUALITY CONTROL**

- .1 Conduct following tests in accordance with Section 01 45 00 - Quality Control, etc.:
  - .1 Circuits originating from branch distribution panels.
  - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .3 Systems: fire alarm system
  - .4 All other electrical systems.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.
- .4 Carry out tests in presence of Contract Administrator and City of Winnipeg.
- .5 Advise Contract Administrator of dates and times for all testing with sufficient advance notice to allow Contract Administrator to make arrangements to attend.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .7 Insert test results and supplier's certifications in Maintenance Manuals.

- .8 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic Site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule Site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .9 Clean and touch up surfaces of Shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .10 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

### **3.6 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.
- .2 Pay all associated fees for inspection of the Work by authorities having jurisdiction.
- .3 Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of Work to Contract Administrator. Copies to be included in Maintenance Manuals.

### **3.7 RESPONSIBILITY**

- .1 Be responsible for any damage caused the City of Winnipeg, or their Contractors due to improperly carrying out this Work.
- .2 Install all components of this Work promptly and where applicable. Provide and set in the proper sequence of construction, all sleeves, hangers, inserts, etc. and arrange for all necessary openings, where required to accommodate the electrical installation.
- .3 Work shall be arranged in co-operation with other divisions of this Specification in such a manner that it doesn't interfere with the progress of the project. In areas where ducts or pipes must be installed along with conduit or cable, co-operate with other divisions so that the finished job will represent the most efficient use of the space.
- .4 In no case proceed with any Work in uncertainty. Obtain, from the Contract Administrator, any clarification necessary and thoroughly understand all portions of the Work to be performed.

### **3.8 CLEANLINESS AND CLEANING**

- .1 This division shall maintain a clean tidy job Site. All boxes, crates, and construction debris due to this portion of the Work shall be neatly piled outside the construction area and shall be removed at least weekly during the construction period. All construction areas shall be kept clear of debris.
- .2 Before the project will be accepted by the City of Winnipeg, all electrical equipment shall be clean and free of dust, plaster, paint, etc. Any equipment which is scratched or damaged shall be refinished or replaced if so designated by the Contract Administrator.

### **3.9 MODIFICATIONS**

- .1 Locations of all receptacles, outlets, switches, etc. are subject to modification by the Contract Administrator, who reserves the right to move these up to 3000 mm from the position shown, without change to the Contract price, provided notice is given before the related Work has commenced.

### **3.10 ENGINEERING OBSERVATIONS**

- .1 The term "Contract Administrator" in all electrical sections of Specification shall mean:  
SMS Engineering Ltd.  
770 Bradford Street  
Winnipeg, Manitoba  
R3H 0N3
- .2 Contractor's Work will be observed periodically by City of Winnipeg, and/or Contract Administrator or their representatives, solely for purpose of determining general quality of Work, and not for any other purpose. Guidance will be offered to Contractor in interpretation of plans and Specifications to assist him to carry out Work. Observation and directives given to Contractor does not relieve Contractor and his agents, servants and employees of their responsibility to erect and install Work in all its parts in a safe and Workmanlike manner, and in accordance with plans and Specifications, nor impose upon City of Winnipeg, and/or Contract Administrator or their representatives, any responsibility to supervise or oversee erection or installation of any Work.
- .3 Contractor shall notify Contract Administrator for a final distribution inspection prior to energizing distribution system. All distribution equipment shall be left with covers removed to allow a thorough inspection.

### **3.11 GUARANTEE**

- .1 Guarantee the satisfactory operation of all Work and equipment supplied and installed as a part of this section of the Specifications.
- .2 Replace forthwith, at no additional Material or labour cost, any part which may fail, or prove defective within a period of twelve (12) calendar months after the final acceptance of the complete installation, provided that such failure is not due to improper usage, or ordinary wear and tear.

- .3 No certificate given, payment made, partial or entire use of the equipment by the City of Winnipeg or his representative shall be construed as acceptance of defective Workmanship or Materials.
- .4 This general guarantee shall not act as a waiver of any specified guarantee or special equipment guarantees covering a greater length of time.

### **3.12 CUTTING AND PATCHING**

- .1 Cutting, patching and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment and piping, and/or installation of new equipment and piping in existing building(s) to be included by Electrical Contractor in Bid Opportunity price. Electrical Contractor to employ and pay appropriate Subcontractor whose Work is involved, for carrying out Work described above.
- .2 Electrical Contractor shall mark all openings required for conduits, cables, ducts, and the like.
- .3 Optional:
  - .1 Perform all cutting and patching required for installing electrical systems.
  - .2 Electrical Contractor shall retain services of Subcontractors to carry out actual Work involved in cutting wall openings, floor openings and the like, and in patching up after installation has been completed.
  - .3 Cutting to be 'neat' sizes. Patch all edges such as cover plates, etc. Hide cut edges.
  - .4 Electrical Contractor to perform all cutting only of existing surfaces as required as a result of the removal and/or relocation of existing equipment and conduit and/or installation of new equipment and conduit in the existing building to be included by the Div. 26 in the Bid Opportunity price.
  - .5 If, in the opinion of Contract Administrator, cutting of holes has been improperly performed (i.e. too large for conduits or cables) Electrical Contractor to do all patching as per original Specifications and all costs will be borne by him.

### **3.13 FIRE ALARM INSTALLATIONS**

- .1 Keep copy of latest edition of CAN/ULC-S524, Installation of Fire Alarm Systems, all time during the construction of the fire alarm system.
- .2 The above standard may be referenced and reviewed during the Contract Administrator's observations.
- .3 It is highly recommended the Contractor to be familiar with the above standard.

### **3.14 FIREPROOFING**

- .1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, seal openings with 3 M Brand Fire Barrier Products or equivalent, to maintain fire rating.
- .2 Seal all holes resulting from removal of cables, conduits and equipment.

.3 Refer to following table for 3M brand products.

Penetrating Item	3M Brand Fire Barrier Product Options	Range of Applications			Concrete Walls and Assemblies		Gypsum Wall Assemblies	
		Penetrating Items	Annular Space	Maximum Opening Size	F Ratings (Hrs)	T Ratings (Hrs)	F Ratings (Hrs)	T Ratings (Hrs)
1. Plastic Pipe/Conduit & Cast-in Coupling	FS-195+ Wrap Strip, CP 25WB+ Caulk or MP Moldable Putty+	PVC: 8 in. Nominal Diameter 4 Wraps/Application	0.2 in.	9 in. Diameter	2	2	2	1-1/2
		PVC: 4 in. Nominal Diameter 3 Wraps/Application	0.75 in.	6 in. Diameter	3	2	2	2
		ABS: 4 in. Nominal Diameter 3 Wraps/Application	0.75 in.	6 in. Diameter	2	2	1-1/2	1-1/2
	PSS 7904 Penetration Sealing System with CP 25 WB+ Caulk	PVC: 4 in. Nominal Diameter	3.0 in.	10 in. Diameter	3	1/2	--	--
		ABS: 4 in. Nominal Diameter	3.0 in.	10 in. Diameter	3 (in wall) 1 (in floor)	3 (in wall) 0 (in floor)	--	--
		PB: 2 in. Nominal Diameter	3.0 in.	8 in. Diameter	1/2	--	--	--
2. Metal Pipe and Conduit	CP 25WB+ Caulk	1 in. Depth of Caulk: 20 in. Diameter	2.5 in.	22.5 in. Diameter	3	0	2	0
	FS-195+ Wrap Strip, CP 25WB+ Caulk or MP Moldable Putty+	4 in. Nominal Metal Pipe	1.75 in.	8 in. Diameter	2	0	2	2
	CS-195+ CompoSite Sheet with FS-195+ Wrap Strip and CP 25WB+ Caulk or MP Moldable Putty+	4 in. Nominal Metal Pipe (Multiple Pipes)	45.0 in.*	30 x 50 in.	4 (both sides) 3 (one side)	3/4 0	--	--
	PSS 7902 Penetration Sealing System CP 25 WB+ Caulk or MP Moldable Putty+	10 in. Nominal Diameter Pipe and 8x16 in Rectangular Cover Plate if fill is less than 10%	9.0 in.	10 x 20 in.	3	0	--	--
	CP 25WB+ Caulk	1/2 in. Diameter Depth of CP-25WB 12 in. Nominal Diameter Pipe	1.2 in.	14 in. Diameter	3	0	--	--
	FD 150 FireDam Caulk	2 in. Depth of FireDam 150 Chaulk 6 in. Nominal Diameter Pipe	2.0 in.	8-1/4 in. Diameter	3	0	--	--
	MP Moldable Putty+	1 in. Depth of Putty: 10 in. Nominal Diameter Pipe	0.75 in.*	12-1/4 in. Diameter	2 (1/2 in. Depth) 3 (1 in. Depth)	0	--	--
3. Insulated Electrical and Communication s Cable	CP 25WB+ Caulk	1 in. Depth of Caulk; 43% of Area Filled, 350 MCM Cable and 100 Pair Telephone Cable	0.75 in.	6 in. Diameter	3	0	2	1-1/2
		1 in. Depth of Caulk; 37% of Area Filled, 3/0 350MCM Cable and 100 Pair Telephone Cable	0.75 in.					
		2-12 in. Depth of Caulk; 59% of Area Filled, 7C/12 AWG Cable, 100 Pair Telephone Cable	0.75 in.					
	FS-195+ Wrap Strip with CP 25WB+ Caulk or MP Moldable Putty+	4 in. Depth of Caulk with FS-195 Wrap; 59% Area Filled, 350 MCM Cable	0.75 in.	6 in. Diameter	2	0	--	--
	CS-195+ CompoSite Sheet with FS-195+ Wrap Strip and CP 25WB+ Caulk or MP Moldable Putty+	Multiconductor 12 AWG Cable, 100 Pair PVC Telephone Cable, Cable Bundle 3 in. Diameter	47.0 in.*	30 x 50 in.	4	1	--	--
	PSS 7904 Penetration Sealing System with CP 25 WB+ Caulk	350 MCM Cable; 30% of Area Filled. Cover Plate required if Fill is less than 10%	11.0 in.	8 x 16 in.	3	1/2	--	--
	MP Moldable Putty+	Telephone Cable; 100 Pair, 40% of Area Filled	0.75 in.	6-1/4 in. Diameter	2	0	--	--
4. Cable Tray	CS-195+ CompoSite Sheet with CP 25WB+ Caulk	Nominal Size Cable Tray 4 x 24 in.; 39% Area Filled in Tray; Cable Size: 300 MCM 4 in. Depth of Chaulk	14.64 in.	12 x 24 in.	3	0	--	--

	PSS 7904-R Penetration Sealing System with CP 25 WB+ Caulk	Nominal Size Cable Tray 4 x 18 in.; 52% Area Filled in Tray; 25 Pair No. 22 AWG Telephone Cable	9.0 in.	10 x 20 in.	3	3/4	--	--
5. Blank Openings and Construction Joints and Expansion Trenches	CP 25WB+ Caulk	1/2 to 1 in. Depth	--	Joint Width	3	3	--	--
		2 in. Depth Cover Plate required when joint width exceeds 2 in.	--	4 in. Diameter Opening 4 in. Joint Width	3	2	--	--
	MP Moldable Putty+	1 in. Depth	--	1 in. Joint Width	2	2	--	--
	PSS 7904 Penetration Sealing System with CP 25 WB+ Caulk	4 in. Depth of Kit. Cover Plate Required.	--	8 x 16 in.	3	1	--	--

\* Distance Measured from the outer edge of the pentrant to the furthest edge of the opening

- .4 Fireproofing of electrical cables, conduits, trays, etc. passing through fire barriers shall conform to local codes and inspection authorities.

### 3.15 SECURITY FASTENERS AND HARDWARE

- .1 Division 26 to install security fasteners required for Division 26 Work.
- .2 Refer to other sections of the Specifications for security hardware.

### 3.16 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with an appropriate voltage in English.

### 3.17 SCHEDULING OF WORK

- .1 Existing buildings will remain in use during construction. Arrange Work so that interruption of services is kept to a minimum. Obtain permission from City of Winnipeg prior to cutting into electrical services. Where deemed necessary by Contract Administrator, temporary electrical shall be installed and/or Work shall be carried out at night and on weekends.
- .2 Contractor to maintain continuous and adequate all existing electrical systems and other services during entire time of this Contract. Provide temporary conduit, wire, equipment, etc. where necessary to meet this requirement.

### 3.18 DEMOLITION OF EXISTING ELECTRICAL

- .1 Remove all unnecessary existing electrical equipment, wiring, fixtures, in those portions of the existing building which are being remodelled or demolished. All devices/fixtures, etc. are not necessarily shown on the plans. The City of Winnipeg shall select from the Materials and/or equipment remaining that which he wishes to retain, and the remainder shall be removed from the Site. Any electrical equipment in remodelled sections or in structures removed or altered, adjacent to new Work, necessary for the operation of existing building, shall be relocated as necessary. All existing equipment re-used shall be made good and guaranteed. Power interruptions to be kept to a minimum and shall be at a time suitable to the building occupant. Refer to Architectural plans for demolition areas/phasing.

- .2 Drawings do not show all electrical requiring removal to accommodate renovations such as receptacles, switches, lights, starters, motors, components, etc. Division 26 shall visit Site, refer to architectural and electrical Drawings and include all costs for demolition.
- .3 Refer to Specification Section 26 05 05 - Work in Existing Building.

### **3.19 TESTING**

- .1 All empty conduits shall be left with an insulated #14 AWG fish wire.
- .2 Keep a record of all final tests, bind, and turn over typewritten results to the Contract Administrator as a part of the maintenance manual. All final test values measured, date of each measurement, company name and signature of person making each measurement shall be neatly recorded. After all tests have been successfully completed, each test report shall contain a summary which clearly states that all results were satisfactory.
- .3 Upon completion of the Work and adjustments of all equipment, all systems shall be tested in the presence of the Contract Administrator to demonstrate that all equipment furnished and installed or connected as a part of this section of the Contract shall function electrically in the required manner as determined by the Contract Administrator.
- .4 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.
- .5 Carry out on-Site testing and commissioning of all high voltage and low voltage switchgear including:
  - .1 Visual inspection
  - .2 Operational tests
  - .3 Relay operation
- .6 Submit a report that includes test results, observations, summary, etc. Test report to clearly state that all results are acceptable.

### **3.1 LIFE SAFETY TESTING**

- .1 Refer to the City of Winnipeg Life Safety Tests in Buildings document. Arrange and carry out life safety test with City of Winnipeg in accordance with this document. Provide all necessary management and coordination. Arrange all necessary involvement from Subcontractors.
- .2 Arrange and conduct 'dry run' tests which will mimic the full life safety test. 'Dry run' test shall be conducted in presence of Contractor and Contract Administrator only.
- .3 Create procedures to demonstrate the operation of the life safety system. Procedures shall include, but shall not be limited to:
  - .1 Operation of fire alarm including demonstration of all controls and interfaces with other systems including, but not limited to operation of smoke control systems, fire pump and security systems.
- .4 Demonstrate all systems under normal and essential power modes.



- .5 Tests shall not commence until fire alarm system is verified and free of all defects.  
Submit final verification report to Contract Administrator 5 Working days prior to life safety test for review.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 00 - Common Work Results - For Electrical.
- .2        Section 26 05 21 - Wires and Cables.
- .3        Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .4        Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.2                REFERENCES**

- .1        American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
  - .1        ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.
- .2        Canadian Standards Association (CSA)
  - .1        CSA C22.2No.0.4-M1982(R1993), Bonding and Grounding of Electrical Equipment (Protective Grounding).

**1.3                WASTE MANAGEMENT AND DISPOSAL**

- .1        Separate and recycle waste Materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.
- .2        Place Materials defined as hazardous or toxic waste in designated containers.
- .3        Ensure emptied containers are sealed and stored safely for disposal away from children.

**1.4                COORDINATION**

- .1        The building shall remain open and in normal operation during the construction period.
- .2        Where existing services such as electrical power, fire alarm system, sound system, etc. are required to be disrupted and/or shut down, coordinate the shut-downs with the City of Winnipeg and carry out the Work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 120 hours in advance of performing Work and obtain City of Winnipeg's written consent prior to implementing.
- .3        Should any temporary connections be required to maintain services during Work in the existing building, supply and install all necessary Material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of the City of Winnipeg and Contract Administrator.

- .4 If existing equipment shown on Drawings is defective it shall be brought to the Contract Administrator and City of Winnipeg's attention prior to Work completion.
- .5 Refer to General Conditions for phasing and staging of Work and adhere to that schedule. Comply with instructions regarding Working hours necessary to maintain the building in operation.

## **1.5 EXISTING DEVICES IN NEW CONSTRUCTION**

- .1 Where existing devices (receptacles, switches, etc.) presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc. or relocate as required to mount the device to the new wall.
- .2 Where existing conduits pass vertically through a floor area, relocate those conduits to be installed concealed in a new wall or surface mounted in a service area. Extend conduit, wiring, etc. as required.
- .3 Existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.
- .4 Where services are concealed within walls, floors or ceilings and cannot be visually identified, Contractor shall provide electronic scanning devices or other approved means to locate and identify concealed services prior to drilling.

## **1.6 SCHEDULE OF WORK**

- .1 Carefully note schedule of Work and include for all requirements to conform to it.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Provide all Materials required for the complete interface and reconnection installation as herein described and as indicated on the Drawings.
- .2 New fire alarm devices, starters, etc. required to be tied in to existing systems shall match the existing devices.
- .3 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturers requirements and instructions.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install boxes, conduit and wiring through existing areas as required for the new installation.
- .2 Add modules, switches, etc. in existing control panels, as required, to extend existing systems to new or renovated areas.

- .3 Patch and repair walls and ceilings in existing areas that have been damaged or cut open due to the new electrical installation.
- .4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 00 - Common Work Results - For Electrical

**1.2                REFERENCES**

- .1        CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
- .2        CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

**1.3                SUBMITTALS**

- .1        Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1        Conductors: stranded for 10 AWG and larger. Size as indicated. Minimum size: 12 AWG.
- .2        Copper conductors: size as indicated, with minimum 600 V insulation of chemically cross-linked thermosetting polyethylene Material rated RW90 and RWU90.

**2.2                TECK CABLE**

- .1        Cable: to CAN/CSA-C22.2 No. 131.
- .2        Conductors:
  - .1        Grounding conductor: copper. (FT4 insulation where exposed).
  - .2        Circuit conductors: copper, size as indicated. Minimum size 12 AWG and larger.
- .3        Insulation:
  - .1        Chemically cross-linked thermosetting polyethylene rated type RW90, minimum 1000 V.
  - .2        Colour code: Black, red, blue and white in 4C cable.
- .4        Inner jacket: polyvinyl chloride Material.
- .5        Armour: interlocking aluminum.
- .6        Overall covering: thermoplastic polyvinyl chloride Material meeting requirements of vertical tray test to CSA C22.2 No. 0.3 with maximum flame travel of 1.2M.
- .7        Fastenings:

- .1 One hole straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables.
- .3 Threaded rods: Minimum 6 mm dia. to support suspended channels.
- .8 Connectors:
  - .1 To be approved for TECK cable.

### **2.3 ALUMINUM SHEATHED CABLE**

- .1 Conductors: copper, size as indicated. Minimum size 12 AWG.
- .2 Insulation: type RA90 rated minimum 600 V.
- .3 Sheath: aluminum applied to form continuous corrugated sheath.
- .4 Outer jacket of PVC applied over sheath meeting requirements of vertical tray test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2M.
- .5 Fastenings for aluminum sheathed cable:
  - .1 One hole straps to secure surface cables 25 mm and smaller. Two hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
  - .2 Channel type supports for two or more cables.
  - .3 Threaded rods: minimum 6 mm dia. to support suspended channels.

### **2.4 CONTROL CABLES**

- .1 Type LVT: soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket, and armour of closely wound aluminum wire.

### **2.5 VARIABLE FREQUENCY DRIVE POWER CABLES**

- .1 For output wiring to the motor from the VFD.
- .2 Use cable specifically designed for Variable Frequency Drives.
  - .1 Teck Drive RX cable as manufactured by Nexans. Minimum size 12 AWG.
  - .2 PVC jacket rated at FT4.
  - .3 Continuous corrugated impervious aluminum shield.
  - .4 CSA approved to standard C22.2 No. 123-96.
  - .5 Teck Drive RX cables are to be installed in connectors specifically made for use with the Drive RX cables.
  - .6 Terminate the Drive RX cable grounds as per the cable manufacturer's instructions, using ground bushings as directed. The ground connections are to be made at the ground points indicated by the VFD manufacturer. Coordinate with Division 25.
  - .7 Installed as per manufacturer's instructions.

- .3 The input wiring to the VFD must be separated from the output wiring from the VFD by a minimum of 300mm.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 To Minimize Voltage Drop
  - .1 All branch circuit wiring and conduit shall be installed to minimize voltage drop. Install additional conduit runs as required to take the most direct and shortest route to outlets, etc.

#### **3.2 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems.

#### **3.3 INSTALLATION OF TECK CABLE 0 -1000 V**

- .1 Group cables wherever possible on channels.
- .2 Single conductor cables shall be installed one cable diam. apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors. Cable armor shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG bare (unless otherwise noted) copper ground wire shall be installed with each feeder. Cable bending radius shall be at least twelve times the overall cable diam. and bends shall not damage or distort the outer sheath.
- .3 Do not install PVC jacketed cables in circulating air plenums.

#### **3.4 INSTALLATION OF ARMoured CABLES**

- .1 Type AC90 armoured cable (BX) shall be used for connections from conduit systems to wiring devices in steel stud partitions and for interconnection of wiring devices within steel stud partitions, cable to be clipped before entering junction or outlet boxes. Cable to be clamped within partitioning with steel galvanized tie-wire.

#### **3.5 INSTALLATION OF ALUMINUM SHEATHED CABLE**

- .1 Group cables wherever possible on channels.
- .2 Single conductor cables shall be installed one cable diam. apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors. Cable armor shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG bare (unless otherwise noted) copper ground wire shall be installed with each feeder. Cable bending radius shall be at least twelve times the overall cable diam. and bends shall not damage or distort the outer sheath.

- .3 Do not install PVC jacketed cables in circulating air plenums.

### **3.6 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Use non-metallic sheathed cable in wood-frame construction only.
- .2 Home runs to panel shall be wire in conduit.
- .3 Install straps and box connectors to cables as required.

### **3.7 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

### **3.8 INSTALLATION OF FIRE ALARM CABLES**

- .1 Do not install cables that are part of the fire alarm system in PVC conduit. This includes but not limited to the following: wiring to fire alarm devices, annunciators, communications wiring, power supply wiring, etc.

### **3.9 INSTALLATION IN EQUIPMENT**

- .1 Group and lace-in neatly wire and cable installed in switchboards, panelboards, cabinets, wireways and other such enclosures.

### **3.10 TERMINATIONS**

- .1 Terminate wires and cables with appropriate connectors in an approved manner.
- .2 Compression adapters intended to terminate larger feeders on small lugs are not acceptable. All lugs, including breaker lugs, are to be sized to accommodate the cable being terminated.

### **3.11 IDENTIFICATION**

- .1 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, color coded as listed below.
- .2 Wire in conduit 1/0 AWG and larger and single conductor cables for normal power feeders shall be identified at each outlet box and termination with a 150 mm band of coloured vinyl tape of the appropriate colour. Emergency power feeders shall be provided with an additional 75 mm band of red vinyl tape installed adjacent to the 150 mm band of the coloured phase identification tape, as listed below. Neutral and ground conductors shall be identified. Paint or other means of colouring the insulation shall not be used.
- .3 Color code wire in conduit and single conductor cables as follows:

Phase A - red  
Phase B - black  
Phase C - blue



- Neutral - white
- Ground - green
- .4 Maintain phase sequence and colour coding throughout project.
- .5 Use colour coded wires in communication cables, matched throughout system.
- .6 Identify control conductors in motor control equipment, contactors, fire alarm panels, etc. with mylar/cloth wire markers.
- .7 Refer to 26 05 00 for additional requirements.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 00 - Common Work Results – For Electrical.
- .2        Section 26 05 05 – Common Work Results (Work In Existing Building) – For Electrical.
- .3        Section 26 05 06 – Common Work Results (Testing of Systems) – For Electrical.

**1.2                REFERENCES**

- .1        Ground equipment to: CSA C22.2 No. 41.
- .2        Copper grounding conductors to: CSA G7.1.
- .3        CSA C22.2No.0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).
- .4        CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1        Grounding conductors: system, circuit and equipment, grounding conductors to be bare (or minimum #12 AWG insulated if installed in a raceway or as indicated/required) stranded copper sized in accordance with the Canadian Electrical Code or as indicated.
- .2        Insulated grounding conductors: green, type RW-90, FT-6 rated where installed in free air.
- .3        Ground bus: copper, size 6 mm by 50 mm by 300 mm (1/4” x 3” x 12”)long complete with insulated supports, fastenings, connectors, etc. Located as shown on the Drawings.
- .4        Non-corroding accessories necessary for grounding system, type, size, Material as indicated, including but not necessarily limited to:
  - .1        Grounding and bonding bushings.
  - .2        Grounding or bonding clamps. All grounding and bonding clamps shall be brass where attached to copper pipes. Clamps for other applications shall be of a type and Material that will minimize deterioration from galvanic action due to dissimilar metals.
  - .3        Bolted type conductor connectors.
  - .4        Cadweld welded type conductor connectors.
  - .5        Bonding jumpers, straps.
  - .6        Pressure wire connectors.
  - .7        Cable tray ground clamps.
  - .8        All compression connectors, logs, etc. used in grounding circuits in any location, shall have bolts, nuts, etc. of silicone bronze alloy equal to “Everdur” metal.

**Part 3 Execution**

**3.1 INSTALLATION GENERAL**

- .1 The grounding of the electrical system shall conform to the requirements of the electrical code, the inspection authority having jurisdiction and shall be as indicated on the Drawings. Additional grounding requirements shall be as described in this Specification and as shown on the Drawings.
- .2 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 For a single ground conductor installed in EMT or rigid steel conduit provide permanent and effective connection to the conduit at each end. Use solderless lugs, clamps or ground bushing at each end.
- .6 All ground/bonding cables, bus, etc., in locations where subject to mechanical damage, shall be protected by rigid metal conduit, steel guards, or other suitable shields. In all cases where rigid metal conduit or other metallic encasement of ground/bonding conductors is required, the conductor shall be permanently and effectively bonded to the conduit/enclosure at both ends of its length. Use solderless lug, clamp or ground bushing at each end. This requirement applies to all such enclosures regardless of length.
- .7 Make buried connections, by cadweld process.
- .8 Use two hole, long barrel, copper compression lugs for grounding connections to equipment.
- .9 Install bonding wire for flexible conduit, connected at both ends to conduit by using grounding bushing, solderless lug or clamp.
- .10 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .11 All bonding jumpers shall be sized at least equal to their corresponding grounding conductors unless noted otherwise. Where attached to equipment, conduits, cabinets, etc., suitable approved two hole, long barrel, copper compression lugs shall be used.
- .12 No soldered connections shall be used on grounding circuits at any point.
- .13 In wet or damp areas and near tanks containing liquids, all equipment frames, tanks, boxes, outlets, etc., shall be securely bonded together and grounded.
- .14 Connect building structural steel and metal siding to ground by cadwelding to steel.
- .15 Where a ground cable is to be bonded to building steel, the location of such ground connections shall be at points where they will not be subject to mechanical damage, but if possible will be accessible for inspection.
- .16 Connections to steel shall consist of Cadwelding.

- .17 Any bonds between dissimilar metals such as between copper and steel, must be thoroughly sealed or painted against moisture to minimize corrosion.
- .18 All surfaces to which grounding bus or cable is to be bolted shall be cleaned of all paint, rust, etc., and Worked to a bright flat surface. Immediately before bolting to steel member, the contact surface of both shall be lightly coated with an oxide-preventing agent.
- .19 All connections to be buried and subsequently made inaccessible must be Cadwelded.
- .20 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .21 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .22 Where ground conductors pass through fire rated floor, or wall, etc., provide rigid metal conduit of the required size. Connect each conduit end to the grounding/bonding conductor with solderless lug, clamp or grounding bushing. Firestop penetration through fire rated walls and floors. Refer to Sections 07 84 00, and 26 05 00.
- .23 Where ground connections will be inaccessible after construction, connections shall be made by the cadweld process (Erico Products 'Cadweld' or Burndy 'Thermoweld'). Accessible connections shall be Cadweld, welded, brazed, bolted, or compression type.
- .24 All conduit runs containing feeders and branch circuits shall be complete with an insulated green ground wire bonded to all outlet boxes, junction boxes, pull boxes, equipment enclosures, etc. The conduit system shall be continuous but shall not be relied on to serve as the equipment grounding means. Ground conductors shall be sized according to the Canadian Electrical Code, but shall be minimum #12 AWG.
- .25 Ground conductors shall be run with all single conductor cable feeders (RA-90, Teck, M.I., etc). Multi-conductor cables shall use the internal bonding conductor or sheath unless otherwise noted.
- .26 For feeders to 600 Volt sub-distributions, the insulated ground wire shall be minimum #3/0 AWG (to allow the future grounding of transformer neutral points for transformers fed from the 600 Volt subdistribution). All locknuts and couplings shall be securely tightened.
- .27 Conduit expansion joints and telescoping sections of metal raceways and cable trays not thoroughly bonded otherwise, shall be provided with approved bonding jumpers.
- .28 Where ground conductors pass through floor slabs, building walls, etc., and are not encased in rigid metal conduit, sleeves of approved non-metallic Material of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.
- .29 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .30 In general, circuits for system grounding and equipment bonding shall be separate and independent of each other. No bond or common connection shall exist between these two installations, except the basic ground to which each is connected.

- .31 For power systems, all metal ducts, bus enclosures, motor frames, steel supports for starters, panels, switches, etc., which are not rigidly secured to, and in contact with the grounded structural metal frame of the building, and conduit system, or which are subject to excessive vibration and possible loosened ground contacts, shall be securely bonded to building steel or to the conduit system by means of stranded copper jumpers. Jumpers shall have circular-mil cross section of not less than 30 percent of that of the largest conductor entering the enclosure being grounded, with a minimum size of No. 6 AWG copper being used in any jumper.

### **3.2 CABLE SHEATH GROUNDING**

- .1 Bond metallic sheath and concentric neutral conductor/tape of single conductor cables together at supply end only. Insulate metallic sheath and concentric neutral conductor/tape at load end.
- .2 Use No. 6 AWG flexible copper wire, clamped, to cable sheath and/or concentric neutral/tape.
- .3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

### **3.3 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral points of 600V and 208 V system.

### **3.4 EQUIPMENT BONDING**

- .1 Install bonding connections to typical equipment included in, but not necessarily limited to following list: service equipment, switchgear, panelboards, transformers, frames of motors, motor control centres, starters, control panels, building steel Work, panels, capacitor banks, etc.

### **3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator, if provided, during tests.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            Section 26 05 00 - Common Work Results - For Electrical

**Part 2            Products**

**2.1                SUPPORT CHANNELS**

- .1            U shape, size and thickness as required, surface mounted, suspended.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Secure equipment to masonry, tile and plaster surfaces with nylon shields.
- .2            Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3            Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .4            Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5            Fasten exposed conduit or cables to building construction or support system using straps.
  - .1            One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2            Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3            Beam clamps to secure conduit to exposed steel Work.
- .6            Suspended support systems.
  - .1            Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2            Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7            For surface mounting of two or more conduits use channels.
- .8            Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9            Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10          Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            Section 26 05 00 - Common Work Results - For Electrical.

**1.2                SUBMITTALS**

- .1            Submit Shop Drawings and product data for cabinets in accordance with Section 26 05 00 - Common Work Results - For Electrical.

**Part 2            Products**

**2.1                JUNCTION AND PULL BOXES**

- .1            Welded steel construction with screw-on flat covers for surface mounting.
- .2            Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3            Cast type with gasketed covers where exposed to moisture or weather or where specified.
- .4            Explosion proof in hazardous areas to suit the hazardous classification.

**Part 3            Execution**

**3.1                JUNCTION, PULL BOXES AND CABINETS**

- .1            Install pull boxes in inconspicuous but accessible locations.
- .2            Mount cabinets with top not higher than 2 m above finished floor.
- .3            Install terminal block as indicated in Type T cabinets.
- .4            Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .5            Install junction and pull boxes clear of all mechanical ductwork and piping.

**3.2                IDENTIFICATION**

- .1            Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2            Install size 2 identification labels indicating system name, voltage and phase.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            26 05 00 - Common Work Results - For Electrical
- .2            26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

**1.2                REFERENCES**

- .1            CSA C22.1, Canadian Electrical Code, Part 1.

**Part 2            Products**

**2.1                OUTLET AND CONDUIT BOXES GENERAL**

- .1            Size boxes in accordance with CSA C22.1.
- .2            102 mm square or larger outlet boxes as required for special devices.
- .3            Gang boxes where wiring devices are grouped.
- .4            Blank cover plates for boxes without wiring devices.
- .5            Combination boxes with barriers where outlets for more than one system are grouped.
- .6            Sectional boxes shall not be used without specific approval of the Contract Administrator.
- .7            In finished areas receptacle shall be stainless steel. In finished area ceilings, junction and pull box covers shall be solid covers, painted to match the finish of the adjacent surface.
- .8            In moist or dusty areas, gasketed watertight or dust tight boxes and covers shall be provided.
- .9            Explosion proof in hazardous areas to suit requirements of authorities having jurisdiction.

**2.2                SHEET STEEL OUTLET BOXES**

- .1            Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 102 mm square outlet boxes with extension and plaster rings as required.
- .2            Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3            102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

**2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

**2.4 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

**2.5 CONDUIT BOXES**

- .1 Cast FS or FD ferrous boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle where exposed to moisture.

**2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

**2.7 MOULDED VAPOUR BARRIER BOXES**

- .1 Moulded box vapour barrier: factory moulded polyethylene box c/w flange for use with recessed electric switch and outlet boxes.

**2.8 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

**2.9 SERVICE FITTINGS**

- .1 Pedestal type 'high tension' receptacle fitting, 5" square low profile, 2 piece; steel frame with black plastic housing for two duplex receptacles. Bottom plate with knockout and BX connector for centered installation.
- .2 Pedestal type 'low tension' fitting 5" square low profile, 2 piece steel frame with black plastic housing to accommodate two amphenol jack connectors. Bottom plate with slot for conduit entry.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.

- .2 Fill boxes with paper, sponges or foam or similar approved Material to prevent entry of debris during construction. Remove upon completion of Work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Wires in outlet, junction and switch boxes, not having a connection within box shall not be spliced, but shall continue unbroken through the box.
- .6 Maintain continuity of vapor barrier where boxes are installed in exterior walls and ceilings. Use air/vapor barrier boxes for outlets installed in walls or ceilings with a vapor barrier.
- .7 Boxes to be mounted plumb and square with building lines.
- .8 Where outlet boxes are shown on the Drawings as being "back-to-back" shall have a minimum offset of 200 mm (8") between boxes to reduce sound transmission. In no case shall "thru-wall" boxes be used.
- .9 Install pull boxes, or fittings, in conduit runs where more than four bends are necessary.
- .10 Install pull boxes where run exceeds 23.0 (75 feet) in length.
- .11 All junction, outlets and pull boxes shall be so installed that they are always readily accessible.
- .12 No power driven pins (Ramset) shall be utilized to secure boxes without specific approval from Contract Administrator.
- .13 Check opening provided for each recessed outlet box and if it is not completely covered by cover plate, report discrepancy to the division responsible and ensure that it is rectified.
- .14 All concealed junction boxes, conduit fittings, etc. to be c/w galv. steel covers, secured with two bolts.
- .15 Co-ordinate boxes in masonry with brick or block configuration, boxes to be saw cut in bottom of appropriate brick or block. They shall be of sufficient depth to allow conduit to pass through center of block.
- .16 Apply acoustic sealant to seal wires penetrating moulded vapour barrier boxes.
- .17 No more than two extension rings shall be used in sequence.
- .18 For installations in hazardous areas, moist areas, dusty areas, etc., meet all requirements of authorities having jurisdiction.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results - For Electrical
- .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
  - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Minimum size of conduit shall be 19mm.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel Work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods to support suspended channels, sized for the load.

**2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- .3 Steel set screw connectors and couplings. Insulated throat liners on connectors.

- .4 Raintight connectors and fittings c/w O-rings for use on weatherproof or sprinklerproof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture or sprinkler heads.
- .5 Explosion proof in hazardous areas to meet requirements of authorities having jurisdiction.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.5 FISH CORD**

- .1 Polypropylene with 3M spare length at each conduit end.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
- .2 Produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.
- .3 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .4 Conceal conduits except in mechanical and electrical service rooms.
- .5 Use rigid galvanized steel threaded conduit where specified.
- .6 Use epoxy coated conduit in corrosive areas.
- .7 Use electrical metallic tubing (EMT) except where specified otherwise.
- .8 Use flexible metal conduit for connection to motors in dry areas, transformers and equipment subject to vibration or movement. Provide a separate insulated grounding conductor within flexible conduit.
- .9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .10 Use explosion proof flexible connection for connection to explosion proof motors.

- .11 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .12 Minimum conduit size power circuits: 19 mm.
- .13 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .14 Mechanically bend steel conduit over 19 mm dia.
- .15 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .16 Install fish cord in empty conduits.
- .17 Run 4-25 mm spare conduits up to ceiling space and 4-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .18 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .19 Dry conduits out before installing wire.
- .20 Conduit stubs from floor slabs where exposed to damage to be rigid galv. steel.
- .21 The conduit sizes as shown or indicated are the minimum acceptable and shall not be reduced without the approval of the Contract Administrator.
- .22 Conduit to be sized as per Canadian Electrical Code or as shown on Drawings and Specifications. Note that the sizes of branch circuit conductors scheduled and/or specified on the Drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit.
- .23 Running threads will not be permitted; proper couplings shall be used.
- .24 Not less than 900mm (3'-0") of flexible conduit (and of sufficient length to allow the lighting fixture to be relocated to any location within a 6 ft. (1.8m) radius) shall be used for the connection of recessed lighting fixtures. A separate drop to be used for each fixture unless fixtures are mounted in continuous rows.
- .25 Liquid tight flexible conduit runs shall not exceed 1.5m.
- .26 No circuits fed from emergency or essential power sources shall be run in the same conduit as other systems.
- .27 Provide separate conduit system for emergency distribution.
- .28 All conduit runs passing across expansion joints of the building shall be installed utilizing approved expansion fittings, and bonding devices.
- .29 Refer to 26 05 00 for identification requirements.

- .30 All conduit systems in hazardous areas to be rigid galvanized steel to meet the requirements of the authorities having jurisdiction.
- .31 No power driven pins (Ramset) shall be utilized to secure any portion of the conduit.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.3 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

**END OF SECTION**



**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Materials and installation for standard and custom breaker type panelboards.

**1.2                RELATED SECTIONS**

- .1            Section 26 05 00 - Common Work Results - For Electrical.
- .2            Section 26 28 21 - Moulded Case Circuit Breakers.

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CSA C22.2No.29, Panelboards and enclosed Panelboards.

**1.4                SUBMITTALS**

- .1            Submit Shop Drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2            Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**Part 2            Products**

**2.1                BREAKERS**

- .1            Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2            Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

**2.2                EQUIPMENT IDENTIFICATION**

- .1            Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2            Nameplate for each panelboard size 4 engraved as indicated.
- .3            Complete circuit directory with typewritten legend showing location and load of each circuit.

**2.3                MANUFACTURERS**

- .1            Acceptable Manufacturers: Cutler Hammer, Schneider, Square D and Siemens.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Connect loads to circuits.
- .2 Connect branch circuit neutral conductors to common neutral bus. Common neutrals shall be shared by vertically adjacent breakers except for GFI protected branch circuits shall not share neutrals with other circuits. Neutral conductors shall be identified with mylar/cloth wire markers showing the circuit numbers of the circuits sharing the neutral.
- .3 Wiring in panelboards shall be neat and set in as if laced. All neutral conductors shall be identified in the panel with their associated circuit numbers by means of Brady Markers.
- .4 All panelboards throughout the building shall be phased together such that the left-hand, centre and right-hand panelboard busses represent phases A, B and C respectively. All indicating meters shall be identified to this sequence.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1    Section 26 05 00 - Common Work Results - For Electrical.
- .2    Section 26 05 21 - Wires and Cables.
- .3    Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .4    Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .5    Section 26 28 23 - Disconnect Switches - Fused and Non-Fused up to 1000V.

**1.2                REFERENCES**

- .1    American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
- .2    Canadian Standards Association (CSA)
  - .1    CSA C22.2No.0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).

**1.3                SYSTEM DESCRIPTION**

- .1    Provide complete electrical power and control connections for mechanical equipment, except as noted herein.

**1.4                COORDINATION**

- .1    Verify electrical supply characteristics of all equipment prior to rough-in. Report any discrepancies immediately. Revise wire sizing, device type, connection type, breaker size, etc., as required, to accommodate the electrical supply characteristics of the equipment supplied by other trades.

**Part 2            Products**

**2.1                MATERIALS**

- .1    Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2    Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices and fittings required to provide control wiring for mechanical equipment except for temperature/humidity control systems.

- .3 Unless otherwise noted, motors and control devices shall be supplied by Div. 25. Motor horsepower ratings shall be as shown in the Mechanical Specifications. Motor voltage and phase ratings shall be as shown on the Div. 26 drawings.

## **2.2 EXTERIOR EQUIPMENT**

- .1 All equipment mounted on the exterior of the building shall be weatherproof.

## **Part 3 Execution**

### **3.1 POWER WIRING**

- .1 Install power feeders, starters, disconnects and associated equipment and make connections to all mechanical equipment.
- .2 Install branch circuit wiring for mechanical systems control panels, time clocks and control transformers. Control panels for equipment on emergency power to be connected to emergency branch circuits.
- .3 Install main power feeders to starter/control panels furnished by Mechanical. Install branch circuit wiring for motors, electric coils, etc.

### **3.2 COORDINATION**

- .1 Refer to mechanical drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.
- .2 Obtain full information from Mechanical, regarding wiring, controls, overload heaters, equipment ratings and overcurrent protection. Notify the Div. 21, 22, 23, 25 Subcontractor, at once, if any information provided is incorrect or unsatisfactory.
- .3 Coordinate control wiring requirements and provide all control wiring and connections as required to make the control systems operate as specified.
- .4 Refer to Divisions 21, 22, 23 & 25 Specifications for any further electrical requirements.

### **3.3 SHOP DRAWING REVIEW**

- .1 Review Mechanical equipment Shop Drawings and adjust breaker/feeder sizes as required.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Section 26 05 00 - Common Work Results - For Electrical.
- .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA-C22.2 No.55, Special Use Switches.
  - .4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

**1.3 SUBMITTALS**

- .1 Submit Shop Drawings and product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

**Part 2 Products**

**2.1 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 Vac, 15 A, U ground, with following features:
  - .1 White for normal power, red for emergency power.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Double wipe contacts and rivetted grounding contacts.
- .2 Receptacles of one manufacturer throughout project.
- .3 Acceptable manufacturers: Hubbell, Arrow Hart, Bryant, Pass & Seymour, Slater. Catalogue No. 5262 for all manufacturers.
- .4 Acceptable manufacturers for ground fault receptacles shall be:
  - .1 Arrow Hart - GF 5242
  - .2 Bryant - GFR 52FT
  - .3 Hubbell - GF 5252
  - .4 Pass & Seymour - 1591-R

**2.2 SPECIAL WIRING DEVICES**

- .1 Special wiring devices: as indicated on Drawings.

- .2 Pushbutton stations to be flush or surface mounted as required. Units to be complete with up/down or start/stop buttons, as required, and green pilot light.

## **2.1 COVER PLATES**

- .1 Cover plates from one manufacturer throughout project.
- .2 Stainless steel cover plates for wiring devices mounted in flush-mounted outlet boxes to be minimum plate thickness of 1.0mm.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Cast gasketed cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Receptacles of configurations 5-15R, 5-20R, 5-20RA, 6-15K, 6-20R and 6-20RA where exposed to weather, shall be provided with cover plates suitable for wet locations whether or not a plug is inserted into receptacle.
  - .1 Approved Manufacturers:
    - .1 Cooper WIU-1 (1 gang), WIU-2 (2 gang).
    - .2 Appleton WCDIU1 (1 gang), WCIU2 (2 gang).
    - .3 Hubbell RW57300 (1 gang), RW57750 (2 gang).
  - .7 Where receptacles are installed facing downward, at an angle of 45° or less from horizontal, standard cover plates may be used.
  - .8 Weatherproof cover for switch with gaskets as indicated.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles horizontally at height specified on Drawings.
  - .3 Where switch and convenience outlets are shown close to one another, mount receptacles below and in line with the switch.
  - .4 Where finished construction of walls consist of a symmetrical pattern of wood or other panels, install and locate receptacles and switches as directed to suit the pattern.
  - .5 Suitably ground all receptacles with #12 green insulated wire to outlet box.
- .2 Coverplates:
  - .1 Install suitable common cover plates where wiring devices are ganged.

- .2 Do not use cover plates intended for flush outlet boxes on surface-mounted boxes.
- .3 Provide a coverplate on each outlet.

### **3.2 IDENTIFICATION**

- .1 Identify receptacles with size 1 nameplate indicating panel and circuit number. Nameplates to be mechanically fastened. Refer to Section 26 05 00.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 00 - Common Work Results - For Electrical.
- .2        Section 26 24 17 - Panelboards Breaker Type

**1.2                REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CAN/CSA-C22.2 No.144, Ground Fault Circuit Interrupters.
- .2        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

**1.3                SUBMITTALS**

- .1        Submit product data and Shop Drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2        Submit test report for field testing of ground fault equipment to Contract Administrator and a certificate that system as installed meets criteria specified herein.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144 NEMA PG 2.2.
- .2        Components comprising ground fault protective system to be of same manufacturer.

**2.2                GROUND FAULT PROTECTOR UNIT**

- .1        Self-contained with 15 A, 120 V circuit interrupter and duplex single receptacle complete with:
  - .1        Solid state ground sensing device.
  - .2        Facility for testing and reset.
  - .3        CSA Enclosure 1, surface flush mounted with stainless steel painted face plate.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Do not ground neutral on load side of ground fault relay.



- .2 Pass phase conductors including neutral through zero sequence transformers.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results.
- .2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.
- .3 Demonstrate simulated ground fault tests.
- .4 Submit report of tests to Contract Administrator and a certificate that system as installed meets criteria specified herein. Include copies of report in maintenance manuals.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED WORK SPECIFIED ELSEWHERE**

- .1            Section 26 24 17 Panelboards Breaker Type.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International).
  - .1            CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

**1.3                SUBMITTALS**

- .1            Submit product data & Shop Drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2            Include time-current characteristic curves for breakers with ampacity of 100 A and over.

**Part 2            Products**

**2.1                BREAKERS GENERAL**

- .1            Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2            Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3            Common-trip breakers: with single handle for multi-pole applications.
- .4            Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1            Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5            Circuit breakers with interchangeable trips as indicated.
- .6            Minimum Interrupting Ratings (RMS Symmetrical) unless otherwise indicated:
  - .1            120/208 Volts - 10,000 Amps
  - .2            347/600 Volts - 14,000 AmpsAll devices must be fully rated.
- .7            Maximum breaker sizes, except for motors:
  - .1            20A for #12 copper conductor.
  - .2            30A for #10 copper conductor.

- .3 15A for #12 aluminum conductor.
- .4 25A for #10 aluminum conductor.

## **2.2 THERMAL MAGNETIC BREAKERS DESIGN**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

## **2.3 MAGNETIC BREAKERS DESIGN**

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

## **2.4 MANUFACTURERS**

- .1 Acceptable manufacturers: Cutler Hammer, Schneider, Square D, Siemens.

## **2.5 REQUIRED FEATURES**

- .1 Include:
  - .1 Shunt trip.
  - .2 Auxiliary switch.
  - .3 Motor-operated mechanism c/w time delay unit.
  - .4 Under-voltage release.
  - .5 On-off locking device.
  - .6 Handle mechanism.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED WORK SPECIFIED ELSEWHERE**

- .1            Section 26 05 00 - Common Work Results - For Electrical

**1.2                SUBMITTALS**

- .1            Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International).
  - .1            CAN/CSA C22.2 No.4, Enclosed Switches.
  - .2            CSA C22.2 No.39, Fuseholder Assemblies.

**Part 2            Products**

**2.1                DISCONNECT SWITCHES**

- .1            Fusible and non-fusible disconnect switch in CSA Enclosure and size as indicated. To suit the environment (i.e. weatherproof, watertight, dust-tight, general purpose, etc.)
- .2            Provision for padlocking in on-off switch position by three locks.
- .3            Mechanically interlocked door to prevent opening when handle in ON position.
- .4            Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .5            Quick-make, quick-break action, heavy duty industrial grade.
- .6            ON-OFF switch position indication on switch enclosure cover.
- .7            Disconnect switches located at motors connected to variable frequency drives are to be provided with one Form 'C' electrical contact to interlock from the disconnect to the VFD. The interlock is to operate prior to the main power contacts opening to the motor.

**2.2                EQUIPMENT IDENTIFICATION**

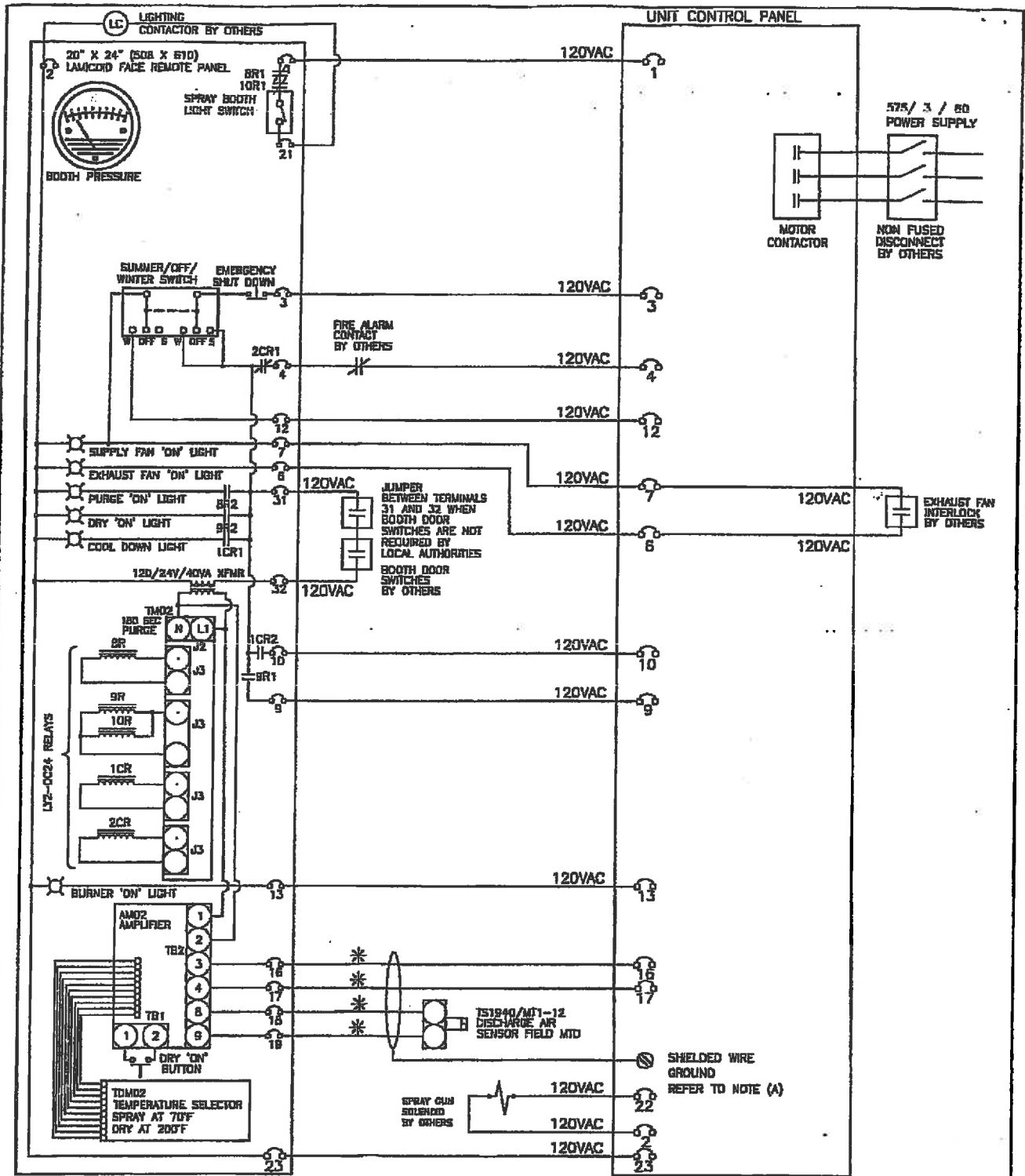
- .1            Provide equipment identification in accordance with Section 26 05 00 - Common Work Result - For Electrical.
- .2            Indicate name of load controlled and voltage on size 6 nameplate.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Install additional brackets, supports, etc. required for mounting the disconnect switches.

**END OF SECTION**



- MAXIMUM CONTROL CIRCUIT AMPACITY 4.17 AMPS AT 120 VAC.
- (A) SHIELD TO BE GROUND AT MAIN ENG A CONTROL CABINET END ONLY. TAPE OTHER ENDS OF GROUND SHIELD TO PREVENT GROUNDING. TAPE ENDS OF ANY UNUSED WIRES.
- \* SHIELDED WIRE IS REQUIRED WITH BMS ANALOGUE SIGNALS. TAPE THE GROUND WIRE & SHIELD TO PREVENT GROUNDING. TAPE THE ENDS OF ALL UNUSED WIRES.
  - \* SHIELDED WIRE IS REQUIRED WITH ELECTRONIC COMPONENTS.
1. FIELD WIRING VOLTAGE DROP NOT TO EXCEED 10%.
  2. ALL WIRING SHOWN SHALL BE COMPLETED BY INSTALLER.
  3. ALL WIRING TO COMPLY WITH THE CANADIAN ELECTRICAL CODE.

HE/CC 43514F1

TAG: MUA-1

HE SERIES SINGLE VOLUME

FIELD WIRING DIAGRAM

**EngA**

**ENGINEERED AIR**

REVISIONS:

DATE:

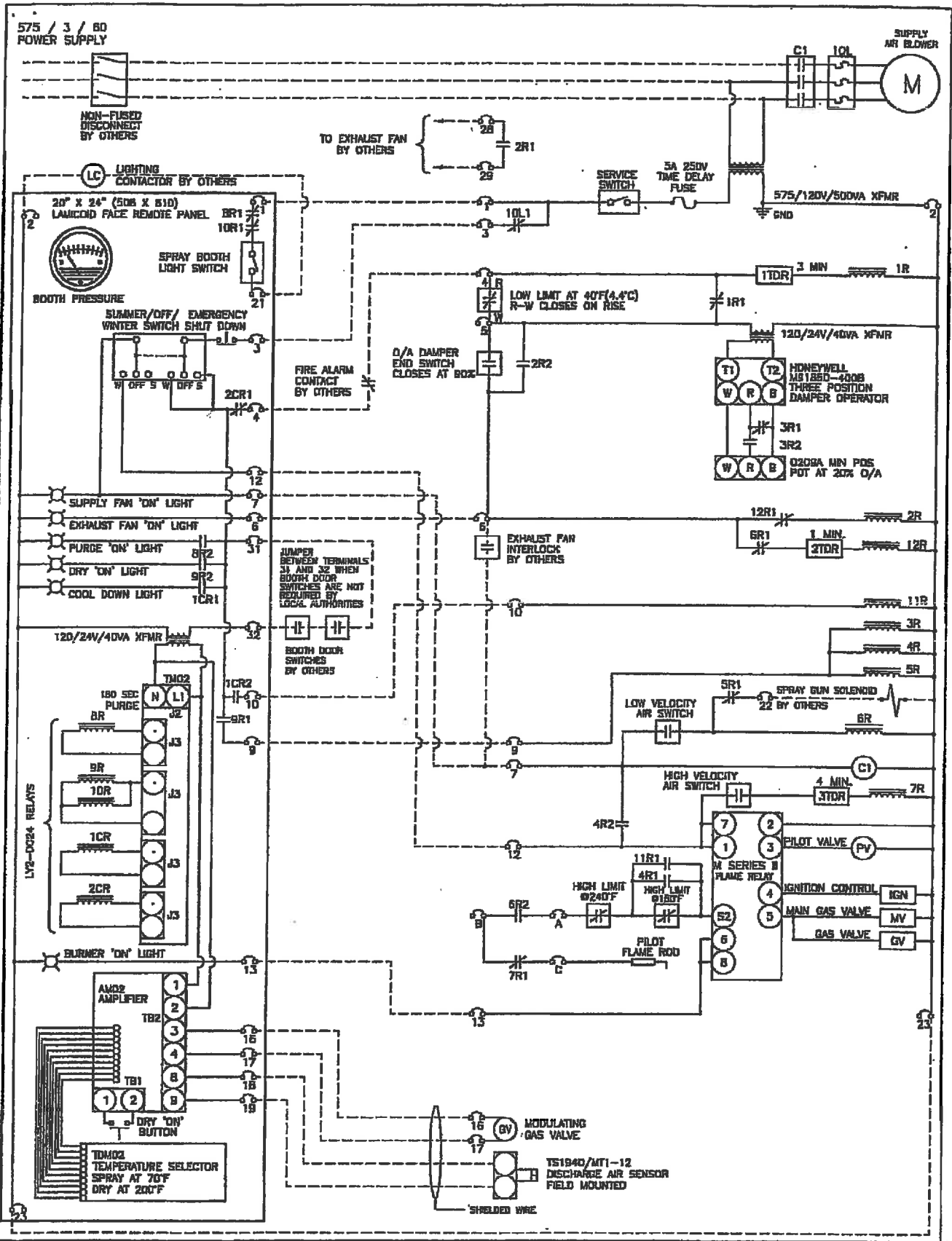
DRN.BY:

CHKD.BY:

DRWG.NO.:

575 / 3 / 80  
POWER SUPPLY

REPLACEMENT WIRE MUST BE EQUIVALENT TO ORIGINAL WIRE SUPPLIED.



INTERNAL WIRING DIAGRAM

TAG: MUA-1

HE SERIES SINGLE VOLUME CONCEPT CURE UNIT

**EngA**

**ENGINEERED AIR**

REVISIONS:

DATE:	DRN.BY:	CHKD.BY:	DRWG.NO.:
JAN 28/08	MN	WT	43614E-01-1

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**TRANSIT GARAGE PAINT BOOTH #4 - MAU REPLACEMENT MOTOR SCHEDULE**



MOTOR No.	NAME	LOCATION	H.P. (kW)	VOLTS	STARTER & ACC.				CIRCUIT	STARTER LOCATION	FEEDER	REMARKS
					MAN	MAG	PL	HOA				
EF-1	EXHAUST FAN	PAINT BOOTH #4 ROOF	15	600 3 ø					MCC-TT	VFD	3#8	TECK DRIVE RX CABLE FROM VFD TO MOTOR
MAU-1	MAKE-UP AIR UNIT	PAINT BOOTH #4 ROOF	20	600 3 ø					PP-UU	N/A	3#6	PACKAGE UNIT